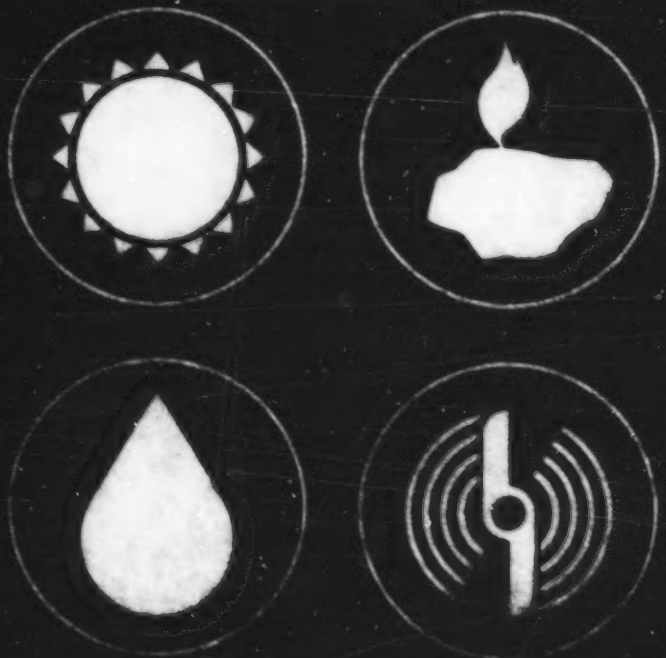
ALBERTA CANADA ENERGY RESOURCES RESEARCH FUND

Seventh Annual Report
April 1, 1982 - March 31, 1983



Alberta

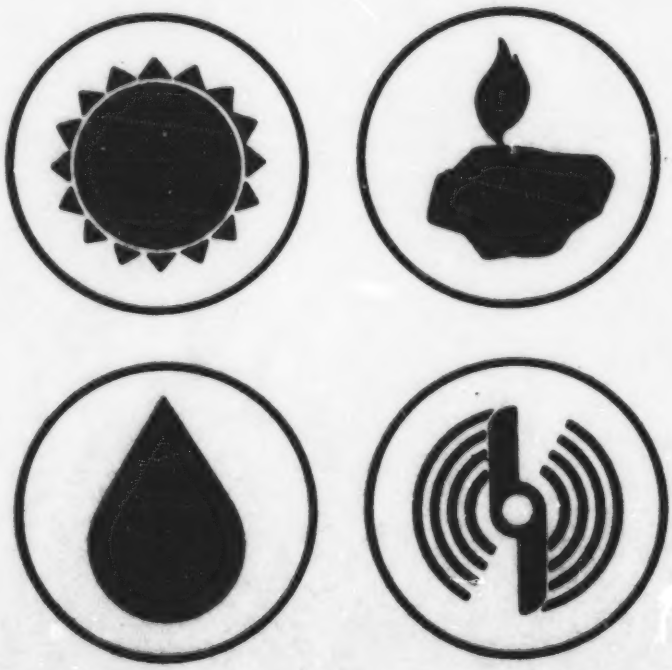
Canada

85-4536/

ISSN 0225-3607
ISBN 0-86499-105-3

ALBERTA/CANADA ENERGY RESOURCES RESEARCH FUND

Seventh Annual Report
April 1, 1982 - March 31, 1983



Alberta
ENERGY AND
NATURAL RESOURCES

Canada
ENERGY, MINES AND
RESOURCES

International Standard Serial Number 0225-3607
International Standard Book Number 0-86499-105-3
Energy and Natural Resources Report Number I/9—82/83

Additional copies of this report are available from:

Alberta Energy and Natural Resources
Information Centre
Main Floor, Bramalea Building
9920 - 108 Street
Edmonton, Alberta, Canada
T5K 2M4

Phone: (403) 427-3590

Aussi disponible en français; s'adresser à:

Energie, Mines et Ressources Canada
580 rue Booth
Ottawa, Ontario, Canada
K1A 0E4

To:

The Honorable John Zaozirny
Minister of Energy and Natural Resources
Edmonton

The Honorable Jean Chretien
Minister of Energy, Mines and Resources
Ottawa

Sirs:

We have the honor to present the Seventh Annual Report relating to the ALBERTA/CANADA ENERGY RESOURCES RESEARCH FUND AGREEMENT for the fiscal year ending March 31, 1983.

Respectfully submitted,

Dr. K. Whitham
Co-Chairman, Alberta/Canada
Energy Resources Research Fund

Dr. G.B. Mellon
Co-Chairman, Alberta/Canada
Energy Resources Research Fund

CONTENTS

INTRODUCTION 1
BACKGROUND 2
ALBERTA/CANADA COMMITTEE 3
PROGRAM OBJECTIVES AND GUIDELINES 4
APPROVED PROGRAMS/PROJECTS 5
- General Energy Research 7
- Capital Projects 19
- Universities Program 21
- Coal Research 25
- Energy Conservation and Renewable Energy 35

FINANCIAL STATEMENT 45

INTRODUCTION

The Seventh Annual Report summarizes activities conducted under the terms of the Alberta/Canada Energy Resources Research Fund (A/CERRF) for the period April 1, 1982 to March 31, 1983. During this time the fund supported 19 energy-related research and development programs and/or projects in the following five areas, including the design and construction of a new coal research facility at Devon:

General Energy Research	6 programs/projects
Capital Projects	1 project
Universities Program	1 program
Coal Research	2 programs
Energy Conservation and Renewable Energy	9 programs/projects

Detailed information on these is provided in the section entitled "Approved Programs/Projects".

BACKGROUND

The Alberta/Canada Energy Resources Research Fund was created as a result of the March, 1974 oil-pricing agreement between the producing provinces and the federal government.

To minimize the economic impact of crude oil price increases in Canada, it was agreed to hold the wellhead price of domestic crude oil at $6.50/barrel from April 1, 1974 to June 30, 1975. In recognition of Alberta's agreeing to sell its crude oil below international prices, the federal government committed itself to provide increased funds to assist Alberta in strengthening and diversifying its economy.

The money eventually amounted to a federal commitment of $144 million with $96 million to be directed to energy-related research projects, starting with a transfer of funds in the 1976/77 fiscal year.

Following an exchange of letters between the Prime Minister of Canada and the Premier of Alberta in October and November, 1976, agreement was reached on the terms of reference of the Alberta/Canada Energy Resources Research Fund. The responsibility of applying and administering the fund was assigned to the Alberta/Canada Committee made up of senior Alberta and federal officials.

ALBERTA/CANADA COMMITTEE

The Prime Minister of Canada and the Premier of Alberta agreed upon the following terms for the operation of the Alberta/Canada Committee:

i) The committee will consist of three senior officials from each of the Alberta and federal governments.

ii) Based upon proposals made by or acceptable to Alberta, the committee will agree in principle on the broad scope of a long-term energy-research program to be carried out.

iii) The committee will meet annually to review progress and to agree upon the energy-related projects that will make up the research program for the one-year period immediately ahead. A review of the previous year's progress will also be made.

iv) Once agreement has been reached on the list of projects for the one-year immediately ahead, arrangements will be made by the federal government to transfer to the Alberta government the block of funds for the year in question. Where the committee has, in its annual review, included a project on the list after considering a detailed proposal, Alberta will be free to pass the required funds from the block directly to the Alberta department or agency responsible for the project. Where the committee does not have available, at its annual review, the detailed proposal concerning any project included in the list, funds pertaining to that project will be retained by Alberta in a special account until the committee has been able to review and agree upon a detailed proposal. (It would be accepted that review and agreement in such cases might well be achieved through correspondence.)

v) With respect to the research projects carried out, results will be incorporated in reports recording the data and concepts developed, and such reports will be fully available to the Alberta and federal governments.

On March 31, 1983 the Alberta/Canada Committee members were:

ALBERTA

— Dr. G. B. Mellon (Co-Chairman), Deputy Minister, Energy and Natural Resources
— Dr. C. W. Bowman, Chairman, Alberta Oil Sands Technology and Research Authority
— Mr. R. D. McDonald, Executive Director, Scientific and Engineering Services, Energy and Natural Resources

CANADA

— Dr. K. Whitham (Co-Chairman), Assistant Deputy Minister Research and Technology, Energy, Mines and Resources
— Dr. P. J. Dyne, Director General, Office of Energy Research and Development, Energy, Mines and Resources
— Dr. J. H. Walsh, Senior Special Advisor, Coal, Conservation and Non-Petroleum Sector, Energy, Mines and Resources.

PROGRAM OBJECTIVES AND GUIDELINES

The Alberta/Canada Energy Resources Research Fund has two basic objectives:

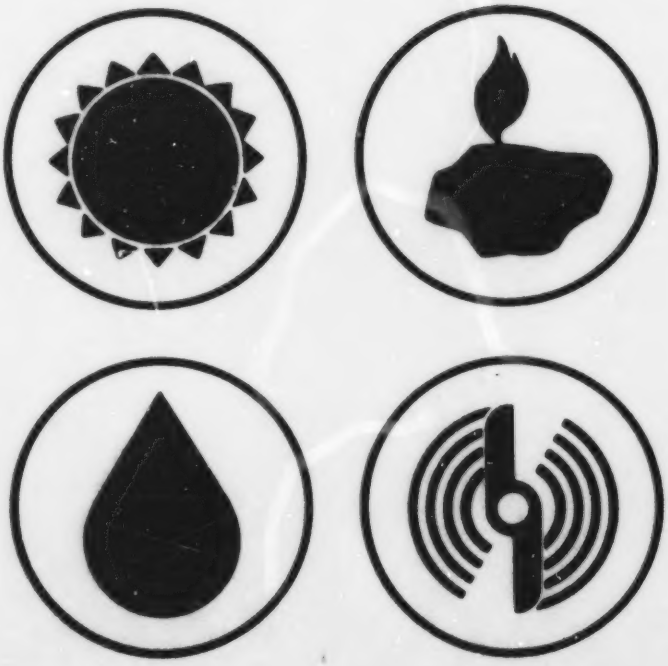
- to promote and support research into the development and efficient use of Alberta's existing and potential energy resources, having regard for the province's and Canada's medium- and long-term energy needs; and
- to encourage the development of Alberta-based scientific and technical expertise in the field of energy research and development.

Proposals for specific research projects are reviewed and assessed within the context of the following program guidelines:

1. The Alberta/Canada Energy Resources Research Fund program shall include research on both renewable and non-renewable (fossil fuel) resources, generally excluding, however, oil sands and conventional and heavy crude oil. Alberta government funding of research into the development and utilization of these important resources is carried out through a Crown agency, the Alberta Oil Sands Technology and Research Authority (AOSTRA).
2. Eligible research projects shall include those relating to exploration, production, transportation, conservation and utilization of Alberta's energy resources. Current areas of importance include research, development and demonstrations related to coal and energy conservation and renewable energy.
3. Preference will be given to applied or mission-oriented research projects, although some consideration will be given to funding of appropriate basic research projects.
4. An attempt will be made to develop a reasonably wide spectrum of projects with prospects for both short- and longer-term benefits.
5. Consideration will be given, under certain circumstances, to proposals for construction of new or improved physical facilities for energy-related research in Alberta.
6. To the most practical extent possible, preference will be given to projects utilizing Alberta-based scientific and engineering expertise.
7. The Alberta-based private sector will be encouraged to participate directly in the program, through submission of appropriate research proposals and through representation on specific project management and technical advisory committees.
8. Most approved projects will be carried out under a legal agreement between Alberta Energy and Natural Resources and the researchers, specifying the terms and conditions under which the research funds will be expended and the technology disclosed, owned and licensed.

Research proposals may be directed to: The Manager, Research Programs, Alberta Energy and Natural Resources, 9th Floor, South Petroleum Plaza, 9915 - 108 Street, Edmonton, Alberta T5K 2C9.

APPROVED PROGRAMS/ PROJECTS



GENERAL ENERGY RESEARCH

Highlights

Four of six active programs/projects have been completed during the year. Particular developments and achievements include:

- The Petroleum Recovery Institute has developed a sophisticated research facility and consolidated its expertise in enhanced oil recovery technology. Its focus for future activities is directed toward increased private sector contract research.
- The Computer Modelling Group has established itself as a self-contained organization providing expertise in the field of oil reservoir and recovery process computer modelling for the fossil resource industry. The company services industry, agencies and institutions on a worldwide basis and is currently being restructured to give industry members greater responsibility for its operations.
- Alberta Helium demonstrated the technical feasibility of helium recovery from natural gas, using membrane permeation technology. The current worldwide demand for helium, however, limits early commercialization of the new method.
- The Hydrocarbon Research Centre also consolidated its operations and is now funding six active projects. Particular success was achieved through the discovery of a new class of polar compounds, fluorenols, by O. P. Strausz of the University of Alberta in his study, "Chemical Stabilization of the Polar Fractions of Petroleum for Study by Field Ionization Mass Spectroscopy". The other five projects related to Alberta's coal and oil resources are also progressing well.
- In co-operation with the Canadian Gas Processors Research Fund and Gulf Canada, Dr. Dalla Lana of the University of Alberta successfully tested a novel Claus catalyst under field conditions at the Gulf Nevis plant.

More detailed information is given in the following description of individual programs and projects.

ENHANCED RECOVERY OF CONVENTIONAL CRUDE OIL

Contractor: Petroleum Recovery Institute, Calgary

Expenditures:

1982/83	$ 358 083
Total to Date	$ 3 131 044

Objectives: To accelerate the institute's research into improved recovery of conventional crude oil and to assess new enhanced recovery techniques with respect to Alberta's crude oil reservoirs.

Results: During 1982/83, an extensive program of laboratory test work and engineering studies relating to the Beaverhill Lake Pool of the Snipe Lake Oil Field was completed. This was conducted as part of a co-operative undertaking to assist the unit operator and the participants of the producing unit in reaching a conclusion concerning the suitability of miscible fluids (hydrocarbon or carbon dioxide) for the enhanced recovery project for this and similar oil reservoirs.

The initial stage of a review of oil fields currently producing from the Nisku type of carbonate reefs was completed. The review will be of assistance for those who may wish to consider the possibility of increasing recovery of oil from this type of field by the use of flooding techniques utilizing nitrogen at high pressure.

Implications: It is believed that an additional 300 to 475 million cubic metres of oil could be recovered by enhanced recovery methods. This represents a potential increase of 40 percent of the remaining established conventional crude oil reserves in Canada which would be recovered by normal production methods or by normal production assisted by waterflooding.

A/CERRF funding has allowed the Petroleum Recovery Institute to expand its capability and focus its efforts on areas of technology likely to be important in Alberta in the next few years.

Publications: Collins, H. N., Batycky, J., De Bree, C., Gross, A. A., Hayashitani, M., Ito, Y., Lim, T., and Yeung, Y. 1982. *Sweep Improvement Study, Chauvin South Sparky A & B Pool.* Calgary: Petroleum Recovery Institute. (PRI 82-9)

Collins, H. N., Hayashitani, M., Yeung, Y., Batycky, J., and Moon, D. 1982. *The Use of a Chemical Tracer in the Chauvin S. Sparky A & B Pool.* Calgary: Petroleum Recovery Institute. (PRI 82-5)

Dolph, J., and Nelson, D. 1983. "Facies and Porosity Distribution in the Swan Hills Reef Complex of the Snipe Lake Oilfield". Paper presented at Joint Meeting of Canadian Society of Petroleum Geologists and Canadian Well Logging Society, Calgary, Alberta, January 11, 1983.

Novosad, J., Baxter, L., and Moon, D. 1983. *Laboratory Evaluation of Lignosulfonates as Sacrificial Adsorbates in Surfactant Flooding.* Calgary: Petroleum Recovery Institute (PRI 83-1). Paper presented at Petroleum Society of the Chemical Institute of Mining and Metallurgy, 34th Annual Technical Meeting, Banff, Alberta, May 10-13, 1983.

Novosad, J., and Myers, A. L. 1982. "Thermodynamics of Ion Exchange". *Canadian Journal of Chemical Engineering* 60, No. 4:500-503.

Novosad, J., Maini, B., and Batycky, J. P. 1982. *A Study of Surfactant Flooding at High Salinity and Hardness.* Calgary: Petroleum Recovery Institute, 1982 (PRI 82-7) and *American Oil Chemists' Society Journal* 59, No. 10:833-839.

Vrbik, J. 1982. *New Formula for Calculating the Pseudo-Skin Factor Duc to Partial Well Completion.* Calgary: Petroleum Recovery Institute. (PRI 82-6)

_____. 1982. *Rigorous Treatment of Pseudo-Skin Factor and Calculation of Oil-Flow Profile under Partial Well Completion.* Calgary: Petroleum Recovery Institute. (PRI 82-8)

COMPUTER MODELLING TECHNOLOGY

Contractor: Computer Modelling Group, Calgary

Expenditures:

1982/83	$ 200 000
Total to Date	$ 2 494 188

Objectives: To develop expertise in mathematical and computer modelling relating to the recovery of Alberta's fossil fuel resources.

Results: Substantial effort was directed toward optimization, addition of new user-oriented options and development of new, more efficient numerical techniques for the Computer Modelling Group (CMG) programs. Significant advances were made in:

(1) iterative methods for solving large systems of equations
(2) chemical flood simulation
(3) efficient phase behavior calculation method
(4) modelling of steam additive recovery processes.

The other aspects of the CMG work are related to the utilization of its models in service projects for industry and the sale of its models to industry. Over the year several companies used services provided by CMG, and CMG programs were sold to companies in Canada and abroad.

This project has now been completed. CMG consolidated its expertise and operation and will be adopting a more market-oriented position seeking future support from the private sector.

Implications: CMG was established as a direct result of the availability of A/CERRF funding. This funding combined with the dedication and capability of the staff and management of CMG has created a viable new Canadian capability with a promising future. As a result, improved oil recovery from Alberta's reservoirs can be expected. The need to import simulation technology to Canada has been substantially reduced and CMG is developing an international reputation.

Publications:

Aziz, K. 1982. "Modelling of Condensate Reservoirs". Paper presented at the North Sea Condensate Reservoirs and their Development Seminar, London, England, May 21, 1982.

Behie, A., and Forsyth, P. A., Jr. 1982. *Direct and Iterative Solution Methods for Fully Coupled Wells.* Calgary: Computer Modelling Group. (CMG.R6.04)

_____. 1982. *Incomplete Factorization Methods.* Calgary: Computer Modelling Group. (CMG.R6.03)

_____. 1982. *Multi-Grid Solution of Three-Dimensional Problems with Discontinuous Coefficients.* Calgary: Computer Modelling Group. (CMG.R17.02)

Behie, A., and Vinsome, P. K. W. 1982. "Block Iterative Methods for Fully Implicit Reservoir Simulation". *Society of Petroleum Engineers Journal* 22, No.5:2.

Buchanan, W. L. 1983. *A Preliminary Investigation of Modelling Steam Additives.* Calgary: Computer Modelling Group. (CMG.R14.01)

_____. 1983. *Sensitivity Study of Field Scale Combustion Simulation for a Lloydminster-Type Heavy Oil Reservoir.* Calgary: Computer Modelling Group. (CMG.CR.01)

Ford, G. 1982. *Improvements in the Handling of Capillary Pressure and Relative Permeability in ISCOM.* Calgary: Computer Modelling Group. (CMG.R4.06)

Forsyth, P. A., Jr., and Collins, D. 1983. *Further Developments in Incomplete Factorization Methods.* Calgary: Computer Modelling Group. (CMG.R6.06)

Li, Y. K., and Nghiem, L. X. 1982. *The Development of a General Phase Envelope Construction Algorithm for Reservoir Fluid Studies.* Calgary: Computer Modelling Group. (CMG.R12.01)

_____. 1982. "The Development of General Phase Envelope Construction Algorithm for Reservoir Fluid Studies". Paper (SPE 11198) presented at the 57th Annual Fall Technical Conference of the Society of Petroleum Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers, New Orleans, Louisiana, September, 1982.

Nghiem, L. X., and Heidemann, R. A. 1982. *General Acceleration Procedure for Multiphase Flash Calculation with Application to Oil-Gas-Water Systems.* Calgary: Computer Modelling Group. (CMG.R12.02)

_____. 1982. "General Acceleration Procedure for Multiphase Flash Calculation with Application to Oil-Gas-Water Systems". Paper presented at Second European Symposium on Enhanced Oil Recovery, Paris, France, November, 1982.

Rubin, B., and Buchanan, L. 1983. "General Purpose Thermal Model". Paper (SPE 11713) presented at 53rd Annual California Regional Meeting, Ventura, California, March, 1983.

Rubin, B., and Erian, A. 1982. *A Multi-Layered Fully Implicit Well Model.* Calgary: Computer Modelling Group. (CMG.R11.02)

Sammon, P. H. 1983. *Heat Loss in Thermal Simulation and its Connection with Error Controlled Timestep Selection.* Calgary: Computer Modelling Group. (CMG.R4.07)

Sammon, P. H., and Forsyth, P. A., Jr. 1982. *Gas Phase Appearance and Disappearance in Fully Implicit Black Oil Simulation.* Calgary: Computer Modelling Group. (CMG.R6.05)

Sammon, P. H., and Rubin, B. 1982. *Error Controlled Simulator Time Step Selection.* Calgary: Computer Modelling Group. (CMG.R4.06)

Siu, A., and Nghiem, L. X. 1982. *On the Modelling of Non-Radial Flow Around Wells in Reservoir Simulation.* Calgary: Computer Modelling Group. (CMG.R8.05)

HELIUM RECOVERY FROM NATURAL GAS

Contractor: Alberta Helium Limited, Calgary

Expenditures:

1982/83	$ 110 956
Total to Date	$ 3 300 000

Objectives: To investigate the technical and economic feasibility of new and less energy-intensive technology for the recovery of helium from Alberta natural gas.

Results: This project is completed. The technical feasibility of recovering helium from Alberta natural gases by membrane permeation methods has been demonstrated. Preliminary design of a commercial plant, based on pilot plant data, has been developed. The process appears to be commercially competitive for recovery of helium from natural gas streams at concentrations below one percent but current helium market conditions are limiting the prospects for near-term commercialization.

Implications: A system has been developed to process pipeline gases and remove the helium. The new system is less costly and consumes less energy to obtain equivalent volumes of helium. Thus, the helium resources of the province may become the source of supply for Canada's future helium requirements and possibly for export. The membrane technology developed has applications in the separation of other industrial gases.

HYDROCARBON RESEARCH

Contractor: Hydrocarbon Research Centre, Inc., Edmonton

Expenditures: 1982/83 $ 298 296
Total to Date $ 1 188 680

Objectives: To encourage fundamental studies related to the development of Alberta's fossil fuel resources.

Results: Six projects are currently in progress:

L. R. Plitt and B. C. Flintoff: Mathematical Modelling of Auto-Medium Cyclones.

Considerable advances have been made in understanding the influence of changes in the design of cyclone coal-cleaning equipment upon the quality of the product obtained from Alberta's friable mountain coals.

S. M. Farouq-Ali: Chemical Flooding Process for Light Oil Reservoirs.

Microemulsions suitable for a chemical flooding process to enhance conventional oil recovery from the Bonnie Glen field have been developed and tested on reservoir cores. Most encouraging results have been obtained and this information is being incorporated into a mathematical reservoir model in an attempt to develop a suitable strategy for a field trial.

O. P. Strausz: Chemical Stabilization of Polar Fractions of Petroleum for Study by Field Ionization Mass Spectrometry.

Considerable progress has been made in the development of the mass spectral capability for analysing Alberta's fossil fuel resources by field ionization mass spectrometry. Attention was focused upon the nitrogen-containing species in the resin fraction of petroleum. Four distinctly different series of nitrogen compounds have been discovered. This information may enable suitable model compounds to be selected for nitrogen-removal studies by hydrogenation.

F. D. Otto: Hydroprocessing of Coal-Based Liquids for Removal of Detrimental Constituents: Organic Sulphur and Nitrogen.

A study was made of the removal of nitrogen from coal liquids and heavy gas oils, doped with known nitrogen compounds, by high pressure catalytic hydrogenation. Nickel-molybdenum catalysts were found to be more effective than nickel-tungsten catalysts for removal of nitrogen from heavy gas oil. However, the two catalysts were approximately equally effective for the removal of nitrogen from coal liquids.

S. E. Hrudey: Coal Conversion Waste-Water Technology.

A new technology to treat waste-water from synthetic fuel plants based upon the anaerobic digestion of phenols by converting them to methane and carbon dioxide is under investigation. Special microbial cultures are being evaluated to degrade the more resistant phenolic compounds.

N. Berkowitz: Catalyzed Supercritical Gas Extraction of Coal and Primary Coal Liquids.

An investigation is in progress to explore the generation of synthetic liquid fuels by extracting coal with various solvents in the supercritical state. The equipment required to conduct this experimental work has been assembled and pressure-tested during the year and has now reached the operational stage.

Implications: A fundamental understanding of the chemistry of the asphaltenes, bitumen and coal, and of the technology in these diverse areas should assist the exploration, recovery, upgrading and utilization of these resources.

CATALYST EVALUATION IN AN INDUSTRIAL CLAUS PROCESS TEST REACTOR

Contractor: Canadian Gas Processors Research Fund (CGPRF), Calgary, and University of Alberta, Edmonton

Expenditures:		
1982/83	$	19 992
Total to Date	$	56 315

Objectives: To test, in the field, a novel Claus process catalyst developed with funding from the CGPRF.

Results: Testing of both the novel and industrial bauxite catalysts was completed. Over approximately three months of continuous operation, the novel catalyst exhibited superior performance for the conversion of hydrogen sulphide and sulphur dioxide to elemental sulphur. Comparable performance for the hydrolysis of carbonyl sulphide was observed at temperatures at least 20°C below those normally employed in a commercial first-stage plant reactor. A final report was issued during April, 1983.

Implications: Use of the novel catalyst in existing plants could conceivably result in the gain of a few additional percentage points of sulphur recovery. The resulting lower sulphur content in the plant tail gas should reduce sulphur emissions or lower the investment required for tail gas processing via add-on downstream equipment.

SUPERIOR POLYMERS FOR ENHANCED OIL RECOVERY

Contractor:	Raylo Chemicals, Edmonton	
Expenditures:	1982/83	$ Nil
	Total to Date	$ 186 895
Objectives:	To evaluate existing polymers used for enhanced oil recovery and to develop polymers with superior properties.	
Results:	Previously reported completion of project work has been documented in a final report.	
Implications:	Improvement in shear and chemical resistance of polymers may potentially increase the amount of recoverable oil from established reserves in Alberta.	

CAPITAL PROJECTS

Highlights

The Alberta/Canada Energy Resources Research Fund previously provided financial support for the construction of the Energy Resources Research Building in Calgary. This is now occupied by the Petroleum Recovery Institute, the Computer Modelling Group, the Canadian Energy Research Institute and the Alberta Research Council. Total construction costs for the facility were approximately $3.2 million.

A/CERRF is currently funding the construction of the Energy Resources Research Building in Devon, a facility for coal-related research activities. The project is progressing well as indicated in the following update.

ENERGY RESOURCES RESEARCH BUILDING (DEVON)

Contractor:	Alberta Housing and Public Works, Edmonton	
Expenditures:	1982/83	$ 7 579 298
	Total to Date	$ 8 886 916
Objectives:	To construct a facility for the coal-related research activities of the Alberta Research Council, the Coal Mining Research Centre and the Canada Centre for Mineral and Energy Technology (CANMET), Energy Research Laboratory, Edmonton.	
Results:	The construction of the pilot plant has been completed. Tenders have been called for the balance of the facility and construction has started.	
Implications:	It is expected that provision of this facility for coal research groups in Alberta will encourage close co-operation among them and lead to sharing of technical resources.	

UNIVERSITIES PROGRAM

Highlights

Since its inception, the Alberta/Canada Energy Resources Research Fund has supported a total of 27 university research projects within the following areas:

General/Conventional Energy Resources Research	5 projects
Coal Research	6 projects
Energy Conservation and Renewable Energy Research	
Energy Conservation	6 projects
Solar Energy	5 projects
Geothermal Energy	3 projects
Fusion Energy	2 projects

At present, 21 projects have been completed and documented. In addition, investigations of and/or experimental work in four further projects were successfully completed and respective research reports are being prepared.

With the completion of the Universities Program, including one additional new and two continuing projects, the total projected program expenditures amount to approximately $2.6 million, exceeding the original commitment of $2.5 million.

New proposals submitted by Alberta university researchers, which are related to identified priority areas, will be considered as unsolicited proposals.

The present status of the program is given in more detail in the following description.

ALBERTA UNIVERSITIES PROGRAM

Contractor: Universities of Alberta and Calgary

Expenditures:

1982/83	$ 496 904
Total to Date	$ 2 289 540

Objectives: To encourage research on Alberta's fossil fuel and renewable energy resources by Alberta universities' staff.

Results: During fiscal year 1982/83, 14 active projects were supported in the following research areas:

General/Conventional Energy Resources	3 projects
Coal	4 projects
Energy Conservation and Renewable Resources	
Energy Conservation	2 projects
Solar Energy	2 projects
Geothermal Energy	2 projects
Fusion Energy	1 project

The following projects were completed in the respective research areas:

- General/Conventional Energy Resources:

  S. E. Hrudey, University of Alberta: Anaerobic Methanogenic Treatment of Phenolic Waste-Waters.

- Coal Research:

  L. R. Plitt, University of Alberta: Modelling and Control of Coal Beneficiation Unit Operations;

  D. C. Lawton, University of Calgary: Reflection Seismic Investigation of Western Canadian Coal Fields.

- Energy Conservation Research:

  J. D. Dale, University of Alberta: Alberta Home Heating Research Facility.

- Solar Energy:

  K. C. Cheng, University of Alberta: Application for Boiling and Condensation Heat Transfer to Flat Plate Solar Collectors in Cold Regions;

  R. E. Rink, University of Alberta: Bilinear Controller for Solar Heating Systems.

- Geothermal Energy:

  F. W. Jones, University of Alberta: A Detailed Study of Regions of Geothermal Energy Potential in Alberta.

- **Fusion Energy:**

  A. A. Offenberger, University of Alberta: High Power KrF System for Fusion Energy Research.

Experimental work was also completed on the following four projects and final reports are being prepared:

H. R. Krouse, University of Calgary: Stable Isotope Research in Support of More Effective Utilization of Gas Fields of Alberta;

P. K. Kaiser, University of Alberta: Support Design for Underground Cavities in Weak Rock;

C. M. Rodkiewicz, University of Alberta, and B. Ignasiak, Alberta Research Council: Beneficiation and Transport of the Mined Coal;

J. W. Costerton, University of Calgary: Modification of the "Ice Nucleation" Technique to Produce a Practical Method for Defouling Heat Exchangers.

Two research projects are being continued:

J. Toth, University of Alberta: Investigation of the Relation Between Formation-Fluid Dynamics and Petroleum Occurrences, Taber Area, Alberta;

F. W. Jones, University of Alberta: A Preparatory Study for Application of Geothermal Energy in the Hinton/Edson Area in Alberta.

COAL RESEARCH

Highlights

Extensive efforts have been initiated toward establishing an overall co-ordinated coal research program.

The Coal Mining Research Centre continued its work in the area of mining and beneficiation technology with particular emphasis on coal drying/cleaning processes.

Good progress was also achieved by the Alberta Research Council regarding the evaluation of Alberta subbituminous coals, and the installation and commissioning of major coal liquefaction research facilities is nearing completion.

More detailed information on program progress is provided in the following individual program descriptions.

COAL MINING RESEARCH

Contractor: Coal Mining Research Centre, Edmonton

Expenditures:

1982/83	$ 1 099 318
Total to Date	$ 3 344 964

Objectives: To research, develop and demonstrate new or improved coal mining and preparation technology for the mining and beneficiation of Western Canadian coals.

Results: The mine drainage program has been completed with dramatic improvements in pit conditions. The spoil pile angle has increased from 23° to 33°, the highwall angle from 45° to 70°; the resulting wider pit has allowed three lower seams to be mined, increasing coal recovery from 50 percent to over 75 percent. A study of overland conveyors for coal transport indicated potential economic savings over the truck haulage alternative of 23-32 percent in plains conditions and 36-46 percent for foothills conditions.

A computerized financial model for the economic evaluation of the impact of alternative coal beneficiation processes has been developed. This model takes into account the interactive costs of mining, preparation, waste disposal and transportation together with the users' price formulae. Laboratory examination relating coal drying characteristics to coal rank and quantity of inert materials present is nearing completion.

Development work on a new coal dry cleaning process has been expanded from the bench to the pilot plant scale. Encouraging results suggesting significant commercial potential have been obtained at coal feed rates of five tonnes/hour (25 tonnes/hour of coal plus medium).

Implications: Mining technology studies are directed toward improving coal recovery, reducing mining costs, increasing safety and enhancing reclamation. The coal preparation program is aimed at increasing product yield, reducing costs and decreasing waste disposal problems. The combined efforts of both programs should help maintain the economic efficiency of the domestically consumed coals used primarily for power generation and enhance the marketability and competitiveness of export coals.

Publications: Barron, K. 1982. "Progress in the Mining Technology Program of the Coal Mining Research Centre". *Proceedings of the 6th International Conference on Coal Research.* London, U.K.

Barron, K., Wright, P. L., and Smales, T. 1982. *Guidelines for the Design of Coal Pillars in the #4 Seam at McIntyre Mines Ltd., Grande Cache, Alberta.* Edmonton: Coal Mining Research Centre. (CMRC 82/20-T)

_____. 1983. "Guidelines for the Design of Coal Pillars in the #4 Seam at McIntyre Mines Ltd., Grande Cache, Alberta". *Proceedings of 1st International Conference on Stability in Underground Mining.* New York: Society of Mineral Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers.

Butcher, S. G. 1982. "Beneficiation of Western Canada's Low Rank Coals". *Proceedings of the 6th International Conference on Coal Research.* London, U.K.

_____. 1982. *Canadian Facilities for Coal Research and Development.* Edmonton: Coal Mining Research Centre. (CMRC 82/36-T)

_____. 1982. "Canadian Facilities for Coal Research and Development". *Proceedings of the 2nd Technical Conference on Western Canadian Coals.* Edmonton: Canadian Institute of Mining.

_____. 1982. *Coal Preparation in Western Canada.* Edmonton: Coal Mining Research Centre (CMRC 82/48-T)

_____. 1982. "The Role of Coal Preparation in the Canadian Coal Industry". Canadian chapter in *Coal Preparation and Use — A World Review.* New Delhi: 9th International Coal Preparation Congress.

Butcher, S. G., and McIntosh, R. 1982. *Statistical Data on Coal Preparation.* Edmonton: Coal Mining Research Centre. (CMRC 82/38-T)

Butcher, S. G., and Symonds, D. F. 1982. "A Review of Dry Cleaning Processes". *Proceedings of the 64th Chemical Institute of Canada Coal Symposium: Phoenix of the 80's.* Ottawa: Canadian Society of Chemical Engineers.

Butcher, S. G., and Wright, P. L. 1982. "The Purpose and Practice of Coal Preparation in Canada". *Proceedings of the 64th Chemical Institute of Canada Coal Symposium: Phoenix of the 80's.* Ottawa: Canadian Society of Chemical Engineers.

Chekerda, K., and Germain, R. 1982. *Compilation of Canadian Research Projects in Coal Exploration Mining & Preparation 1982.* Edmonton: Coal Mining Research Centre. (CMRC 82/32-T)

Chopiuk, R. G. 1982. "CMRC Responds to Industry Needs". *CIM Reporter,* September, 1982.

_____. 1982. *Selective Handling Costs for Strip Mine Reclamation.* Edmonton: Coal Mining Research Centre. (CMRC 82/34-T)

Coal Mining Research Centre. 1982. *Coal Mining Research Centre, Annual Report 1981/82.* Edmonton. (CMRC 82/41-AD)

_____. 1982. *Coal Mining Research Program 1980-1985.* Edmonton. (CMRC 82/22-AD)

Germain, R. J. 1982. "Drying Low Rank Coals". *Proceedings of the 2nd Technical Conference on Western Canadian Coals.* Edmonton: Canadian Institute of Mining and Metallurgy.

_____. 1982. "Selective Oil Agglomeration in Fine Coal Beneficiation". Chapter 6 in *Physical Cleaning of Coal.* New York: Marcel Dekker Inc.

Germain, R. J., Butcher, S. G., and Beeckmans, J. M. 1982. "Dry Cleaning of Coal in the Counter Current Fluidized Cascade". *Proceedings of the 14th International Mineral Processing Congress.* Toronto.

Hoffman, G. L., Jordan, G. R., and Wallis, G. R. 1982. *Geophysical Borehole Logging Handbook for Coal Exploration.* Edmonton: Coal Mining Research Centre. (CMRC 81/14-T)

Rashid, M. A. 1982. "Thermal Drying of Western Canadian Low-Rank Coals". *Proceedings of the 2nd Technical Conference on Western Canadian Coals.* Edmonton: Canadian Institute of Mining and Metallurgy.

Rashid, M. A., and Germain, R. L. 1982. *Drying Low Rank Coals.* Edmonton: Coal Mining Research Centre. (CMRC 82/31-T)

Wright, P. L. 1982. *Estimated Surface Mining Costs of Raw Coal prior to Beneficiation.* Edmonton: Coal Mining Research Centre. (CMRC 83/14-T)

COAL RESEARCH PROGRAM

Contractor: Alberta Research Council, Edmonton

Expenditures:

1982/83	$ 4 302 280
Total to Date	$ 8 657 470

Objectives: To evaluate the reactivity of Alberta subbituminous coal under hydroliquefaction and pyrolysis process conditions and to expand the technical data base related to the conversion of these resources into marketable synthetic fuels.

Results: A field sampling procedure for a coal sample bank was established to ensure uniformity of coals tested in-house and at other centres.

Reactivity of six coals from potentially commercial deposits was evaluated in standard autoclaves. Five different liquefaction processes were included in these tests. The validity of the autoclave test results has been confirmed in bench unit tests at Grand Forks Energy Technology Center in Grand Forks, North Dakota, Dow Chemical Company Chemicals Research in Michigan, and in Japan.

The liquefaction results to date have indicated that there are significant differences in coals from different deposits. Optimum process combinations using a selective solvent, carbon monoxide, a dispersed catalyst activated with hydrogen sulfide and two-stage liquefaction were found to reduce hydrogen consumption and to improve both conversion efficiency and liquid yields. Co-processing of bitumen and coal, two major Alberta resources, showed high potential for development.

The reactivity of the six coals and conditions for optimum liquid yields have been identified also from flash-pyrolysis tests, and test data have been compared with results from bench unit tests at Occidental Research Corporation in Irvine, California, and Cities Service Research and Development Company in Tulsa, Oklahoma. Semicontinuous and continuous bench units for hydroliquefaction and pyrolysis processes were commissioned. One flash-pyrolysis and four hydroliquefaction runs were successfully conducted. A fully developed laboratory for coal petrography is dedicated to liquefaction and pyrolysis. An understanding of maceral composition and behavior under different process conditions is expected to improve the data base and may lead to development of low-severity conversion processes.

Implications: Systematic research on and development of liquefaction and pyrolysis will provide information needed to evaluate, adapt and improve processes for converting indigenous coals to marketable liquid products.

Publications:

Alberta Research Council. 1983. *Final Report on Autoclave and Bench Unit Tests Conducted in Japan.* Prepared by the Agency of Industrial Science and Technology and New Energy Development Organization, March, 1983. Edmonton: Alberta Research Council. (YCLQ-25)

Chakrabartty, S. 1982. "Characterization of Coal for Liquefaction Processes". Paper presented at 64th Chemical Institute of Canada Coal Symposium, Canadian Society of Chemical Engineers, Ottawa, 1982.

_____. 1982. "Search for an Inexpensive Method for Coal Liquefaction". Paper presented at the Pan Pacific Synfuel Conference, Tokyo, November, 1982.

Chakrabartty, S., Chambers, A., Campbell, J. D., and du Plessis, M. P. 1982. "Evaluation of Pyrolysis of a Subbituminous Coal". Paper presented at 32nd Canadian Chemical Engineering Conference, Vancouver, October 3-6, 1982.

Chambers, A. K. 1982. *Review of Literature on Experimental Studies of the Pyrolysis and Hydropyrolysis of Coal.* Edmonton: Alberta Research Council. (YCPY-5)

Cyr, N., Gawlak, M., Carson, D., and Ignasiak, B. 1983. "Structural Characterization and Non-Reductively Ethylated Coal by Carbon-13 and Proton NMR". *Fuel.* (In Press)

du Plessis, M. P. 1982. "Coal Conversion Research Program at the Alberta Research Council". *Journal of Canadian Petroleum Technology* 21, No. 4:79-88.

_____. 1982. "Liquefaction Characteristics of Alberta Subbituminous Coals". Paper presented at Canadian Institute of Mining and Metallurgy, 2nd Technical Conference on Western Canadian Coals, Edmonton, June, 1982.

du Plessis, M. P., Moschopedis, S., Gawlak, M., Hawkins, R., Carson, D., Wasylyk, H., Holuszko, M., and Ignasiak, B. 1982. "Liquefaction Characteristics of Alberta Subbituminous Coals". Paper presented at 32nd Canadian Chemical Engineering Conference, Vancouver, October 3-6, 1982.

Gawlak, M., Carson, D., Holuszko, M., and Vernon, D. 1982. *Batch Autoclave Testing of Subbituminous Coals of Alberta; Carbon Monoxide/Steam and Dispersed Catalyst Processes.* Edmonton: Alberta Research Council. (YCLQ-7)

Gibb, W. J., and Ozum, B. 1982. "Finite Element Heat Transfer Modelling of Underground Coal Gasification". Paper presented at Petroleum Society of Canadian Institute of Mining and Metallurgy, 33rd Annual Technical Meeting, Calgary, June, 1982.

Gibb, W. J., Ozum, B., and du Plessis, M. P. 1982. *Optimal Reactor Distribution with Fixed Terminal Constraints.* Edmonton: Alberta Research Council. (YCLQ-14)

Iacchelli, A., and Selucky, M. 1983. *Proximate Analysis of Coal and Solid Products from Coal Conversion by Thermogravimetric Analysis.* Edmonton: Alberta Research Council. (YCLQ-24)

_____. 1983. *Simulated Microdistillation of Coal-Derived Liquids by Thermogravimetry.* Edmonton: Alberta Research Council. (YCLQ-23)

Knill, K. J. 1982. *Laboratory-Scale Flash Pyrolysis of Alberta Subbituminous Coals (Interim Report).* Edmonton: Alberta Research Council. (YCPY-4)

Lewkowicz, L., Badree, K., and Ignasiak, B. 1983. *Effects of Added H_2S or CS_2 on the Liquefaction of Alberta Subbituminous Coals.* Edmonton: Alberta Research Council. (YCLQ-19)

Matyas, R. S., and Peterson, W. J. 1982. *Hydropyrolysis of Alberta Highvale Coal.* Report prepared by Cities Service Research and Development. Edmonton: Alberta Research Council. (YCPY-3)

Moschopedis, S. E., Hawkins, R. W., and Wasylyk, H. 1982. *Co-Processing of Coal with Oil Sands Bitumen and Derivatives: Batch Autoclave Tests.* Edmonton: Alberta Research Council. (YCLQ-13)

Ozum, B., and du Plessis, M. P. 1982. "Coal Liquefaction Heat Transfer, Measurement and Modelling". Paper presented at Petroleum Society of Canadian Institute of Mining and Metallurgy, 33rd Annual Technical Meeting, Calgary, June, 1982.

_____. 1982. *Review of Heat Transfer and the Design of Heat Exchangers for Coal Slurries.* Edmonton: Alberta Research Council. (YCLQ-9)

Ozum, B., and Kovacik, G. 1982. *Rheological Characteristics of Coal Slurries.* Edmonton: Alberta Research Council. (YCLQ-17)

Ozum, B., Gibb, W. J., and du Plessis, M. P. 1982. "Modelling of Liquefaction Reactor". Paper presented at 32nd Canadian Chemical Engineering Conference, Vancouver, October 3-6, 1982.

Ozum, B., Stefurak, G., and du Plessis, M. P. 1982. "Viscosity of Coal-Bitumen and Coal Anthracene Oil Slurries". Paper presented at Petroleum Society of Canadian Institute of Mining and Metallurgy, 33rd Annual Technical Meeting, Calgary, June, 1982.

Parkash, S. 1982. "Changes in the Physical Properties of Coal on Partial Solubilization". Paper presented at 15th Biennial Conference on Carbon. Philadelphia.

_____. 1982. "Determination of Active Metal Sites in Metal Oxide Catalyst by Selective Gas Chemisorption". *Canadian Journal of Chemical Engineering* 60:23.

Parkash, S., and du Plessis, M. P. 1982. "Reactivity of Char from Subbituminous Coal". Paper presented at 32nd Canadian Chemical Engineering Conference, Vancouver, October 3-6, 1982.

Parkash, S., Carson, D., and Ignasiak, B. 1983. "Petrographic Composition and Liquefaction Behavior of North Dakota and Texas Lignite". *Fuel.* (In Press)

Parkash, S., Carson, D., and Soderlind, J. 1982. *Rapid Heating Short Residence Time Liquefaction of Alberta Subbituminous Coals: Miniautoclave Tests.* Edmonton: Alberta Research Council (YCLQ-11)

Parkash, S., Chakrabartty, S., and Berkowitz, N. 1982. "The Role of Acid-Base Sites in the Preparation of Alumina-Supported Platinum Catalysts". *Journal of Fuel Processing Technology* 6:177-182.

Parkash, S., du Plessis, M. P., Cameron, A. R., and Kalkreuth, W. D. 1983. *Applied Coal Petrology — Part 1, Application of Coal Petrography in the Liquefaction of Subbituminous Coals and Lignites.* Edmonton: Alberta Research Council. (YCLQ-21)

Parkash, S., Holuszko, M., Stangl, C., du Plessis, M. P., and Cameron, A. R. 1982. *Application of Coal Petrography in the Liquefaction of Subbituminous Coals and Lignites.* Edmonton: Alberta Research Council. (YCLQ-16)

Parkash, S., Kotanigawa, T., and Chakrabartty, S. 1982. "Changes in Pore Structure of Precipitated Iron Oxide Catalysts". *Fuel Processing Technology* 5:203-221.

Parkash, S., Lali, K., Holuszko, M., and du Plessis, M. P. 1983. *Contribution of Vitrinite Macerals to the Liquefaction of Subbituminous Coals.* Edmonton: Alberta Research Council. (YCLQ-20)

Parkash, S., Stangl, C., and Holuszko, M. 1982. *Petrographic Analysis for a High Volatile Australian Coal and its Liquefied Residue.* Edmonton: Alberta Research Council. (YCLQ-10)

Sands, S. D. 1982. *Liquefaction Characteristics of Highvale Coal in the Dow Coal Liquefaction Process.* Edmonton: Alberta Research Council. (YCLQ-18)

Selucky, M. L. 1982. "Fast Class Separation of Coal Liquids". Paper presented at Fossil Conference on Chemistry and Energy (sponsored by M. S. Doe), Saratoga, Wyoming, July 20-22, 1982.

Selucky, M. L., and Hafermann, P. 1982. *Chromatrographic Separation of Polar Materials from Liquefaction Solvents on Ion-Exchangers.* Edmonton: Alberta Research Council. (YCLQ-12)

Selucky, M. L., Iacchelli, A., Murray, C., and Van Lieshout, T. 1982. *Improvements of Instrumental Proximate and Ultimate Analysis of Coals and Coal Conversion Products.* Edmonton: Alberta Research Council. (YCLQ-15)

Southern, T., and Selucky, M. L. 1983. *Simulated Distillation by Gas Chromatography, Part 1.* Edmonton: Alberta Research Council. (YCLQ-22)

ENERGY CONSERVATION AND RENEWABLE ENERGY

Highlights

The Energy Conservation and Renewable Energy Program provided support for eight individual projects which concentrated on energy-conserving measures in natural gas processing technology, conservation techniques in the housing/building sector, and wind-energy research and development. The program also supported the Solar and Wind Energy Research Program (SWERP) and Solar and Wind Energy Information Centre of the Alberta Research Council.

Program highlights of the year's activities are:

- Based on earlier results, Phase 2 of an energy audit of the Alberta natural gas industry was initiated to develop a strategy for identifying cost-effective improvements.
- The Solar and Wind Energy Research Program (SWERP) Information Centre responded to an average of 150 monthly inquiries; the wind monitoring network was successfully upgraded and the measured data validated.
- The preliminary evaluation of utility records for the 10 energy-efficient houses built for the Energy Efficient Housing Display Program showed annual energy consumptions between 100 to 150 gigajoules per unit for seven houses, indicating lower efficiencies than originally predicted. Three homes showed consumptions comparable to existing standard houses. A detailed monitoring system and performance evaluation method has been develcped and is being implemented.
- A detailed design of a 16 m diameter delta-blade wind turbine coupled with a variable capacity water pumping system has been completed by Abax Energy Services Ltd., Calgary.
- The demonstration and evaluation of commercially available small-scale wind turbines for low head water pumping has been initiated. The test site near Lethbridge was prepared and two of six proposed turbines have been installed.

Further information on these and other projects is provided in the following updated project descriptions.

ENERGY CONSERVATION IN SOUR GAS PROCESSING

Contractor: Bow Valley Research Ltd., Calgary

Expenditures:

1982/83	$ 34 963
Total to Date	$ 953 537

Objectives: To develop improved technology for reducing energy consumption in processing sour natural gas.

Results: Field work was completed for the pilot-scale study of catalytic incineration of sulphur plant waste gases. The results indicated that catalytic incineration can minimize the fuel gas requirement. Indeed, in many cases, fuel gas would not be required during normal operations.

Previous analyses of total energy consumption in sour gas processing plants indicated significant potential for energy savings. Development of an overall strategy for conducting detailed energy analyses of such plants was started.

Implications: These projects are directed toward conservation of a depleting resource, natural gas. Realization of potential savings in Alberta could equal the combined natural gas needs of the cities of Red Deer, Medicine Hat and Grande Prairie.

Publications: Berlie, E. M., Ritter, R. A., and Sames, J. A. 1982. *Energy Consumption in the Natural Gas Industry.* Calgary: Bow Valley Research Ltd.

SOLAR AND WIND ENERGY RESEARCH PROGRAM

Contractor: Alberta Research Council, Edmonton

Expenditures:

1982/83	$ 233 699
Total to Date	$ 1 807 006

Objectives: To assess Alberta's solar and wind energy resources, using sophisticated instrumentation at strategic locations throughout the province; to upgrade library and technical information services on these resources; and to demonstrate solar and wind energy utilization relevant to the Western Canadian climate.

Results: The Solar and Wind Energy Research Program (SWERP) Information Centre responded to an increasing number of information requests at an average of 150 inquiries per month. A bibliographic collection, totalling nearly 8,500 publications, is available at the centre, through interlibrary loan or via remote computer terminals. New entries were recorded into the data base at a rate of 200 publications per month.

The data gathered from the SWERP monitoring network was successfully validated against independent measurements. Monthly solar and wind data summaries are now available upon request.

Implications: An updated information centre provides efficient and convenient access to both Canadian and international current literature on solar and wind energy including some literature on energy conservation. Detailed climatic data is now available for solar and wind energy resource assessment, research and design purposes. In addition, approximately 1,000 persons involved in environmental research in Alberta are potential users of this data.

INSULATION PROPERTIES OF FLAT BUILT-UP ROOFS

Contractor:	Alberta Roofing Contractors Association Ltd., Calgary	
Expenditures:	1982/83	$ 7 980
	Total to Date	$ 55 937
Objectives:	To improve the thermal quality of flat built-up roofs on industrial and commercial buildings without adding significant weight to the structures.	
Results:	The project has been completed. The retrofit roof insulation on the Edmonton test building was removed as a safety precaution following the breakdown of the fabric applied over rigid foam boards. The applied foamed-in-place insulation continued to be monitored at the Lethbridge site and proved to be technically feasible. The method, however, does not appear to be cost-effective at today's energy prices.	
Implications:	While the addition of foamed-in-place insulation to existing roof membranes or commercial buildings appears to be technically feasible, it is unlikely to occur on a large scale.	

ENERGY-EFFICIENT HOUSING DISPLAY PROGRAM

Contractor: Housing and Urban Development Association of Canada, Alberta Council, Edmonton

Expenditures:

1982/83	$ 3 614
Total to Date	$ 224 946

Objectives: To develop energy-efficient housing designs and related construction procedures; to stimulate development by builders and manufacturers of energy-efficient and cost-effective construction techniques and materials; to stimulate an awareness within the residential construction industry of the need for more emphasis on energy conservation; to develop and construct housing models for public viewing and education which use energy-efficient designs and construction methods.

Results: The monitoring program for the project homes was initiated. Utility records were collected and a preliminary analysis shows that the total energy used by each of seven test houses was between 110 and 150 gigajoules, which is below the current average. The energy consumption of the other three houses was comparable to standard homes. In order to analyse the performance of the 10 test homes in greater detail, an electronic monitoring system and methodology was developed and the installation of the instrumentation started. Preliminary monitoring results and the developed monitoring system and method have been documented.

Implications: It is expected that home-heating requirements will constitute 20 to 25 percent of Alberta's energy expenditure over the next decade. The continuing education of both the public and the housing industry about the benefits of energy efficiency must be considered an investment, in view of the profound long-term effects these benefits could have on efficient energy utilization.

The continued monitoring and analysis of the performance of the 10 houses will provide a basis for evaluating the cost effectiveness of specific energy-conserving features.

PASSIVE SOLAR HEATED COMMUNITY CENTRE

Contractor:	Anzac Citizens Association, Anzac and Sunergy Systems Ltd., Carstairs		
Expenditures:	1982/83	$	2 000
	Total to Date	$	14 170
Objectives:	To design a community centre in Anzac, near Fort McMurray, employing passive solar techniques which emphasize energy-efficient features and use local materials.		
Results:	The completed design of the community centre including full working drawings has been documented, describing the proposed approach, design and materials of construction.		
Implications:	The construction of energy-efficient yet low-cost public buildings would help northern communities save on costs of conventional fossil fuels for space heating.		

DEVELOPMENT OF LARGE DELTA-BLADE WIND TURBINES

Contractor: Abax Energy Services Ltd., Calgary

Expenditures:

1982/83	$ 170 400
Total to Date	$ 263 345

Objectives: To prove the design, performance, reliability and economics of the delta-blade wind turbine system for application to a variety of direct water-pumping uses.

Results: The detailed structural design using the computer program Stardyne confirms the preliminary design. Static and dynamic analysis available in this program shows the structure capable of safely withstanding all applied loads. The design of a variable stroke mechanism which adjusts the water pump power output to match wind power is complete and testing of a working model proves the concept. Detailed design drawings for all structural and mechanical components are complete. Fabrication of a prototype delta turbine with the following specifications has started:

Rotor Diameter	16 m
Tower Height	31.36 m
Maximum Power Output	206 kW @ 48 km/h wind speed
Maximum Water Pumping Rate	1.56 m^3/sec @ 48 km/h wind speed and 9.1 m head

Implications: The delta turbine system appears to be a strong competitor in the development of wind energy, both in Alberta and in other regions of the continent. Aside from contributing to the conservation of conventional energy, the delta turbine offers good potential for extensive use in the expansion of irrigation, water and energy systems, and for the development of manufacturing in Alberta.

COMPARISON STUDY OF WIND TURBINES

Contractor:	*Dalcor Group, Edmonton*		
Expenditures:	1982/83	$	14 310
	Total to Date	$	24 996
Objectives:	To conduct a technical and economic analysis comparing different approaches in the utilization of wind turbines for the purpose of water pumping in irrigation systems in southern Alberta.		
Results:	Results of the comparative analysis of five wind turbines using the wind regime of Lethbridge indicate the use of delta-blade wind turbines coupled with a variable capacity pump could become economically competitive with wind turbine aerogenerator/electric pump systems for irrigation systems. The study has been completed and documented.		
Implications:	Further development of the delta-blade wind turbine system appears warranted.		

ENERGY-EFFICIENT MASONRY FIREPLACES

Contractor: Centre for Research and Development in Masonry, Calgary

Expenditures:

1982/83	$	48 820
Total to Date	$	48 820

Objectives: To measure the performance characteristics of a modified fireplace design against a conventional design and to develop a method for rating the efficiency of fireplaces.

Results: The study, comparing the performance of a modified design of a masonry fireplace with that of a conventional design, was completed. The results indicate that very simple changes to the design and construction of a masonry fireplace can improve its energy efficiency, and recommendations for retrofitting existing masonry fireplaces to increase their performance have been made. A viable test method for rating the efficiency of a masonry or metal fireplace has been developed and explained in detail.

Implications: Masonry fireplaces built to the specifications outlined can be net heat gainers. Existing masonry fireplaces can be retrofitted with a resulting increase in their performance. Both methods can lead to energy savings over the conventional designs of fireplaces.

The project results attracted opportunities for further research on safety and deterioration concerns of masonry chimneys and the authors are participating in drafting new standards for masonry fireplaces and chimneys in co-operation with the Canadian Standards Association.

EVALUATION OF SMALL-SCALE WIND TURBINES

Contractor: Drainage Branch, Alberta Agriculture, Lethbridge

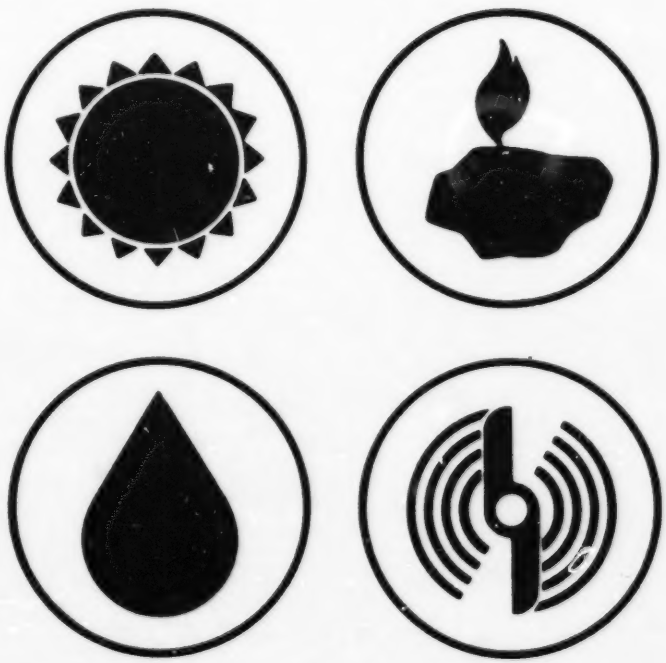
Expenditures:		
1982/83	$	72 386
Total to Date	$	72 386

Objectives: To evaluate and demonstrate the technical and economic potential for utilizing existing wind turbines for low head water pumping in Alberta.

Results: Two of the six proposed turbines have been installed on the test site located north of the Lethbridge Alberta Agriculture Centre. Each turbine has an unlimited water supply from the St. Mary River Irrigation Canal which runs parallel to the test site. Installation of computerized monitoring instrumentation to evaluate wind speed and frequency plus turbine performance is currently underway.

Implications: Compared with electric pumping units which can prove expensive at drainage sites remote from powerlines, relatively inexpensive low-lift wind turbines are expected to provide a practical alternative to farmers for pumping drainage effluent. Therefore, control and reclamation of saline and water-logged lands through installation of subsurface drainage is expected to increase significantly.

FINANCIAL STATEMENT



SUMMARY OF EXPENDITURES

Pursuant to the terms of the November, 1976 agreement between the Prime Minister of Canada and the Premier of Alberta, a sum of $96 million has been transferred to the Province of Alberta.

Funds transferred to the province are deposited to the General Revenue Account, Alberta Treasury, and are subsequently made available to projects approved by the Alberta/Canada Committee by special warrants authorizing expenditures through the appropriations of Alberta Energy and Natural Resources. From April 1, 1982 to March 31, 1983 the amounts shown in the associated table were transferred to, and expended by, the approved projects.

The total expenditures on approved projects from the beginning of the program to March 31, 1983 totalled $44 921 287.

Summary of Transfers To and Expenditures By Approved Projects from April 1, 1982 to March 31, 1983

Project	Balance Brought Forward From 1981/82	Transferred[1]	Expended[2]	Balance[3]
1. Enhanced Recovery of Conventional Crude Oil	$ Nil	$ 355 000	$ 358 083	$ (3 083)
2. Computer Modelling Technology	Nil	200 000	200 000	Nil
3. Helium Recovery from Natural Gas	4 974	105 982	110 956	Nil
4. Hydrocarbon Research	492 616	350 000	298 296	544 320
5. Catalyst Evaluation in an Industrial Claus Process Test Reactor	10 000	9 992	19 992	Nil
6. Superior Polymers for Enhanced Oil Recovery	(5 035)	5 035	Nil	Nil
7. Energy Resources Research Building (Devon)	Nil	7 579 298	7 579 298	Nil
8. Alberta Universities Program	65 220	396 168	496 904	(35 516)
9. Coal Mining Research	179 628	1 051 048	1 099 318	131 358
10. Coal Research Program	(210 406)	2 769 095	4 302 280	(1 743 591)
11. Energy Conservation in Sour Gas Processing	Nil	34 963	34 963	Nil
12. Solar and Wind Energy Research Program	(17 662)	261 221	233 699	9 860
13. Insulation Properties of Flat Built-up Roofs	43	7 937	7 980	Nil
14. Energy-Efficient Housing Display Program	(5 332)	18 000	3 614	9 054
15. Passive Solar Heated Community Centre	Nil	2 000	2 000	Nil
16. Development of Large Delta-Blade Wind Turbines	Nil	170 400	170 400	Nil
17. Comparison Study of Wind Turbines	387	13 923	14 310	Nil
18. Energy-Efficient Masonry Fireplaces	Nil	48 820	48 820	Nil
19. Evaluation of Small-Scale Wind Turbines	Nil	72 386	72 386	Nil
Subtotal	514 433	13 451 268	15 053 299	(1 087 598)
Administration	Nil	164 385	164 385	Nil
Total	514 433	13 615 653	15 217 684	(1 087 598)

[1] Refers to funds transferred by the Department of Energy and Natural Resources to contractors for application to projects in accordance with signed agreements. This includes funds totalling $810 000 transferred from 1981/82 Special Warrant to projects 1, 2, 9, and 18 as an advance against First Quarter 1982/83 project expenditures. This does not include funds totalling $600 000 transferred from 1982/83 Special Warrant to projects 1, 9, 11, and 12 as an advance against First Quarter 1983/84 projected expenditures.

[2] Refers to project expenditure by contractors funded by ERRF transfers. Interest and other revenue amounting to $94 210 have not been included in [1] and expenditures have been reduced by the same amount.

[3] Refers to balance of ERRF funds with contractors at March 31, 1983.